THE WESTERN GAS CONSTRUCTION CO.

GAS ENGINEERS AND BUILDERS

SAN FRANCISCO FORT WAYNE, IND. NEW YORK

BULLETIN No. 201.

"The Western" System of Treating Coal Gas.

AWARDED

GRAND PRIZE & GOLD MEDAL

—AT—

LOUISIANA PURCHASE EXPOSITION, ST. LOUIS, 1904,

BY INTERNATIONAL JURY, TO

THE WESTERN GAS CONSTRUCTION CO.

FORT WAYNE, INDIANA.

No. 731,412. O. N. GULDLIN. PATENTED JUNE 16, 1903.

METHOD OF TREATING GAS.

APPLICATION FILED MAR. 12, 1900. RENEWED MAY 18, 1903.

NO MODEL.

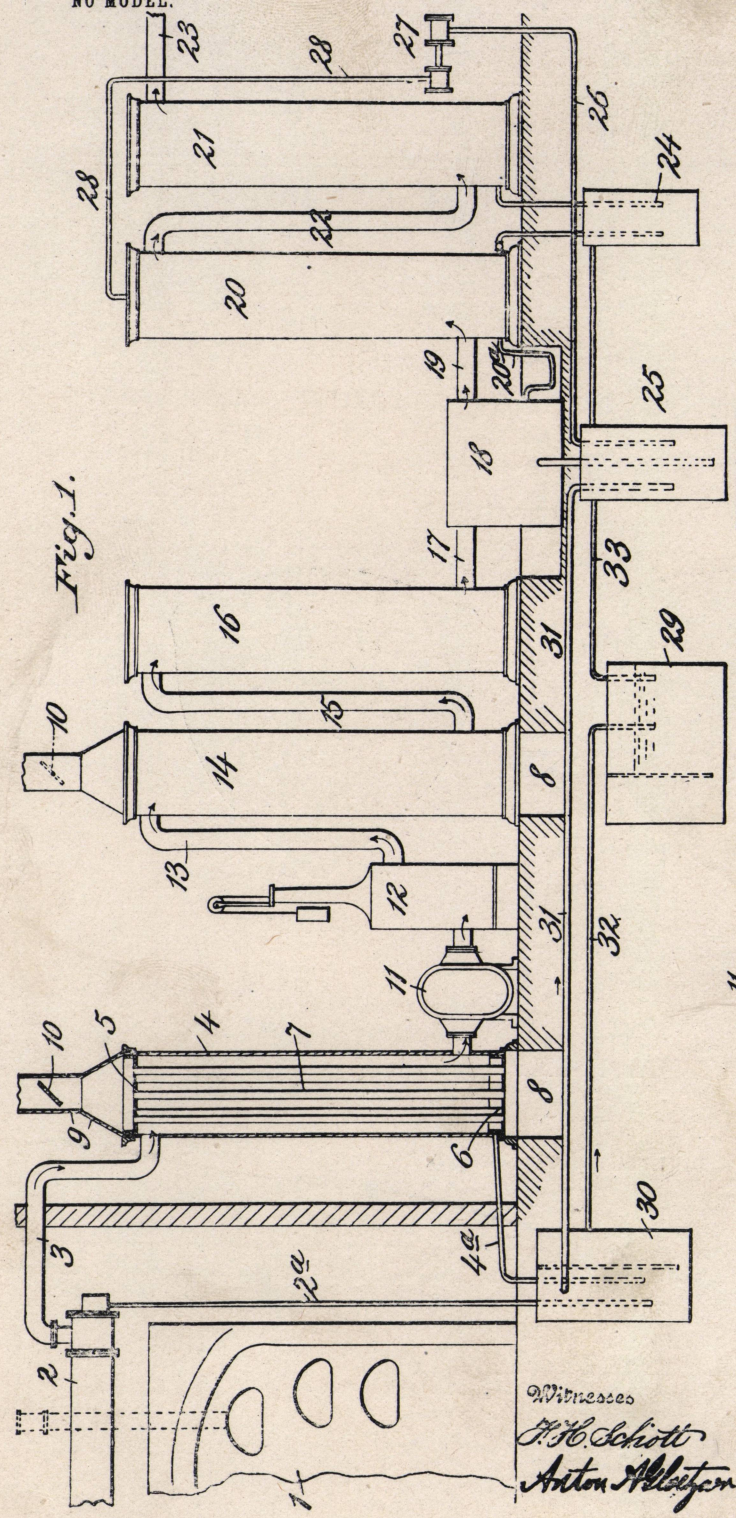

Fig. 1.

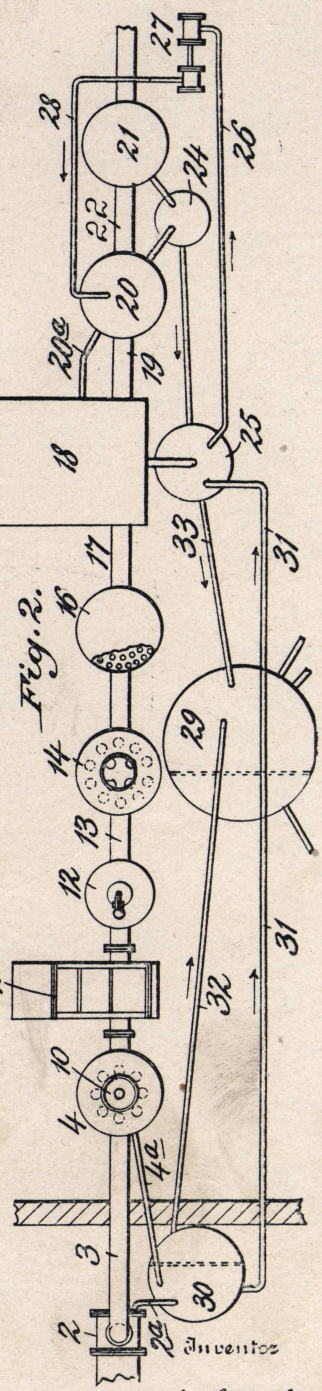

Fig. 2.

Witnesses
H. H. Schott
Anton Ablatzer

Inventor
O. N. Guldlin
By E. B. Clark
Attorney

"THE WESTERN" COAL GAS SYSTEM.

Process Patented June 16, 1903. Filed March 12, 1900.
Apparatus Patented May 23, 1905. Filed December 1, 1902.

What we term our coal gas system embraces our special design and arrangements of the series of apparatus for the treatment of coal gas after it leaves the hydraulic or dry main of the carbonizing plant, and upon it devolves the function of reducing the temperature, eliminating or separating the tar and excessive aqueous and heavy vapors, and finally extracting the ammonia as well as reducing other impurities, such as sulphur compounds and carbonic acid as much as possible previous to final purification in the purifiers. Our Coal Gas System.

The vital importance of proper treatment during this important stage of manufacture seems to have been neglected to a great extent, while the generating system has commanded concentrated attention with the resultant rapid development and magnificent advance during late years in bench construction and coal and coke handling machinery till the difference of a fraction of a cent cost per thousand cubic feet of gas is causing spirited discussion between the advocates of the different apparatus. This interest seemed to stop at the outlet of the hydraulic main, subsequent treatment being apparently too well established, until quite recently, to receive or merit much more than a superficial study and beyond individual annoyances of napthalene, each found "specifics" to get rid of their troubles.

The old rules of condensing surface required per 1000 cu. ft. of gas made originated in rule of thumb and were published in the old text books and faithfully copied in later ones, the question simply having been considered as reduced to the condensation of the tar by an *approximate* cooling surface and the ammonia extraction by water wetted surface. If the candle power dropped out of sight some ready remedy was found to restore it. Old Methods.

The proper treatment of coal gas after it leaves the hydraulic main is of more than equal importance to its production in the generating plant. It is not merely a question of condensing or cooling the gas and its vapors, but during the necessary cooling and purification *to retain in the gas* the maximum possible of all the valuable constituents which give it its illuminating and fuel value, and deliver same to the consumers' burners. This is the principle involved and developed into *our coal gas system* now fully demonstrated and in successful operation in a large number of installations, from the smallest to the largest units under extreme variations of climatic conditions.

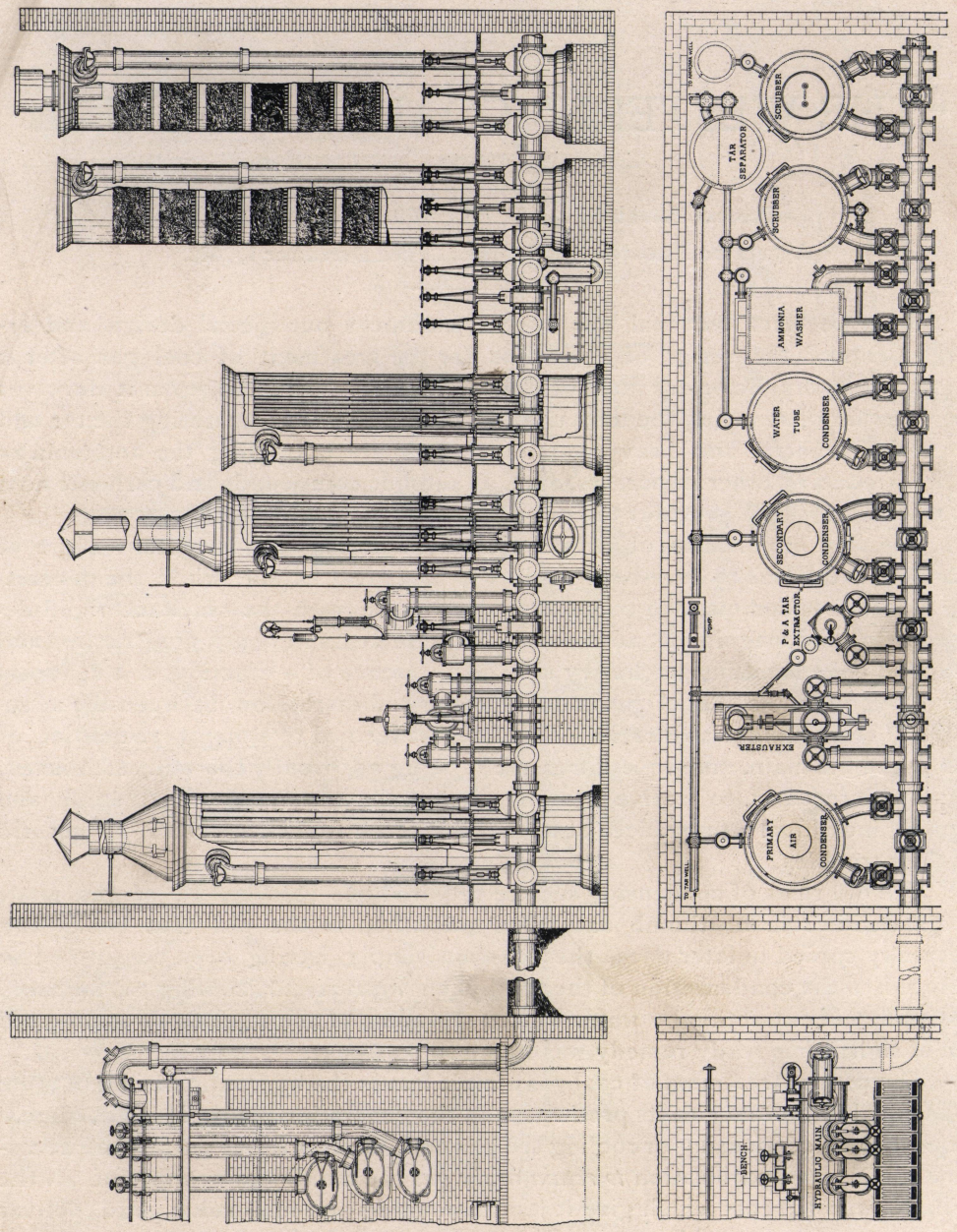

Fig. 3.

The above represents plan and elevation of apparatus embodying the Western Gas System as applied to plant of capacity up to 500,000 cu. ft. daily capacity, and is a copy of our drawing dated March 20th, 1900.

Fundamental Principles.

The principal feature of our system is that covering the condensing or cooling of the gas, embracing a step-down or fractional condensation or cooling with intermediate tar extraction under regulated temperature conditions, fully described and covered by our process patent dated June 16, 1903, No. 731,412, filed March 12, 1900, after previous successful tests in experimental installations.

We present on second page, Figs. 1 and 2, an exact reproduction of the original patent office drawing, as it illustrates the principles involved and described in the following description, and also, incidentally, to properly place the efforts by certain parties who have in a publication entitled "Coal Gas Apparatus" attempted to present as original matter what they, as former employees of the Western Gas Construction Co., had been entrusted with in confidence and knew was protected by a patent already allowed. (Note also Fig. 3.)

The Several Stages of Treatment.

The leading points to be attended to in the condensation of coal gas are the underlying principles of our system, which may be considered in the following stages:

First—To cool the gas and precipitate its vapors to no lower a temperature than at which the volatile hydrocarbons forming its more valuable illuminants, and as such equally valuable for their heat units, shall remain practically unaffected by the tar surfaces which rapidly absorb these at lower temperatures.

Second—To extract the tar quickly at such temperature by mechanical impact, by which the tar is secured of uniform quality, and the gas can then safely enter the third stage.

Third—To accomplish the final gradual cooling, which in our system has been found best attained by dividing the cooling surface required into two stages of one or two units of medium size, giving opportunity for the more economical condensation by secondary air and water, and final water cooling with its wide range of capacity to suit the climatic conditions.

Washing and Scrubbing.

Fourth—The temperature now being safely reduced, the gas enters the last stage of the preparation for final purification, that of washing and scrubbing for the complete extraction of ammonia and partial reduction of H_2S and CO_2. The latter and a partial ammonia extraction, as well as complete deposition of remaining lamp black or soot, is effected in our special design of multiple ammonia washer (our patents No. 677,865 and 764,049, described in separate bulletin No. 202), after leaving which the gas, being freed from mechanical impurities, then for final extraction of ammonia enters, for smaller plants, the tower scrubbers, also divided into two units—the primary and secondary scrubber, or for larger works, we recommend, as more efficient and economical, our Holmes Patent Rotary Scrubber. (See separate bulletin No. 202A). Our tower scrubbers, above mentioned, as suitable for smaller plants, are divided into two units, the "primary" and the "secondary," or finishing scrubber. The latter is periodically flushed with fresh water by a special automatic flushing apparatus, which permits proper measured water supply for quantity of gas made, and at the same time insures uniform wetting of interior surfaces. Through the primary scrub-

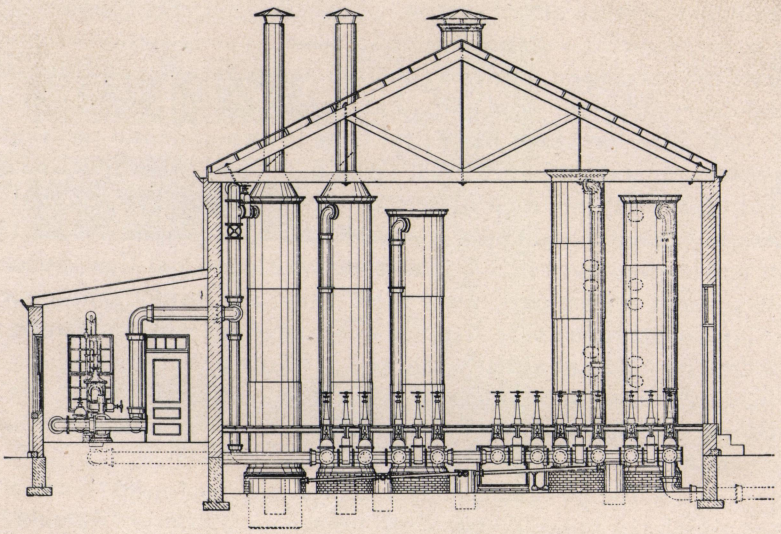

Fig 4.
ELEVATION OF APPARATUS
Showing improved arrangement of Bypass connections with Operating Platform and Valve Stands, Etc.

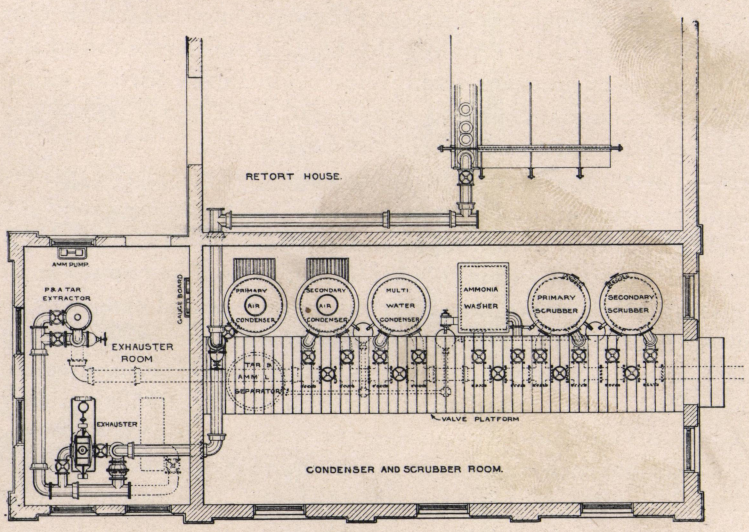

Fig. 5.
PLAN OF APPARATUS.
Showing complete arrangement of Apparatus from the Hydraulic Main, being the Primary Condenser, Exhauster, Tar Extractor, Secondary and Multitubular Condensers, Ammonia Washer, Primary and Secondary Scrubbers, Tar and Ammonia Separator, Bypass connections and provision for future duplication.

ber a constant circulation of weak ammoniacal liquor is maintained by a special pump, the discharge pipe of which is connected to the sprinkler or distributor in top of scrubber and suction pipe to the special drain tank into which overflow from secondary scrubber and multiple washer feed, maintaining a constant supply for pump, as overflow from primary scrubber again feeds into washer. In this manner a repeated circulation of the weak ammoniacal liquor is produced through primary scrubber and multiple washer, a much stronger liquor being obtained and less water required with the attainment of better removal of H_2S and CO_2 from the gas by such liquor, as explained in our bulletins "Ammonia Washers," "Tower Scrubbers," and "Rotary Scrubbers."

Washing and Scrubbing.

It is readily understood that the fresh water supply forming the weak liquor reaching drain tank from final scrubber continuously forces an equal volume of circulated liquor into drain pipes and from same to liquor storage well, or a tar and ammoniacal liquor separator so constructed as to separate by gravity into separate compartments the tar and ammoniacal liquor for independent drains to respective storage wells.

Tar and Ammoniacal Liquor Separator.

Coal gas, as it comes from the hydraulic main, contains, besides these constituents which furnish the illuminating and calorific properties a number of other substances classed together as impurities which consist of various gasses and vapors, as well as some liquid and solid particles which are carried along mechanically.

The most important of these are ammonia, hydrogen-sulphide, carbon dioxide, carbon bisulphide, cyanogen, tar and soot. Of these the ammonia, tar, sulphur and cyanogen are of industrial value, although ordinarily the byproducts are considered to be only tar and ammonia. Cyanogen is not usually extracted in this country, and in most cases the sulphur is not removed from spent oxide. There is, besides those named above, about a gallon and a quarter of water condensed in the cooling of the gas from say 140° to 60° F.

Impurities in Gas.

The constitution of this mixture changes constantly as the temperature falls, the easily condensible vapors and mecanically carried particles dropping out in the mains and condensers. Tar should not remain in the gas below 90°, since at about this temperature its capacity to absorb light-giving hydrocarbons increases very rapidly with the decrease in temperature. The removal of this byproduct is largely by friction and impact, but if no special apparatus giving repeated impact is introduced, same will be carried forward to the scrubbers or even to the purifiers. Its removal is frequently done by the use of washers such as Livseys or by towers filled with slats or baffles and fed with gas liquor, the idea being to combine the removal of tar with that of ammonia. The objection to this is plain on the face of it. The tar as we have seen should be removed above 90°.

Tar Removal.

At this temperature NH3 is much less soluble than at lower temperatures so that the gas liquor used is not greatly strengthened and may be even weakened in the process. Impact being the chief requirement there is no need at this point for the extra circulation necessary to provide for washing. The logical thing is to use the impact principle alone. An apparatus for this purpose should

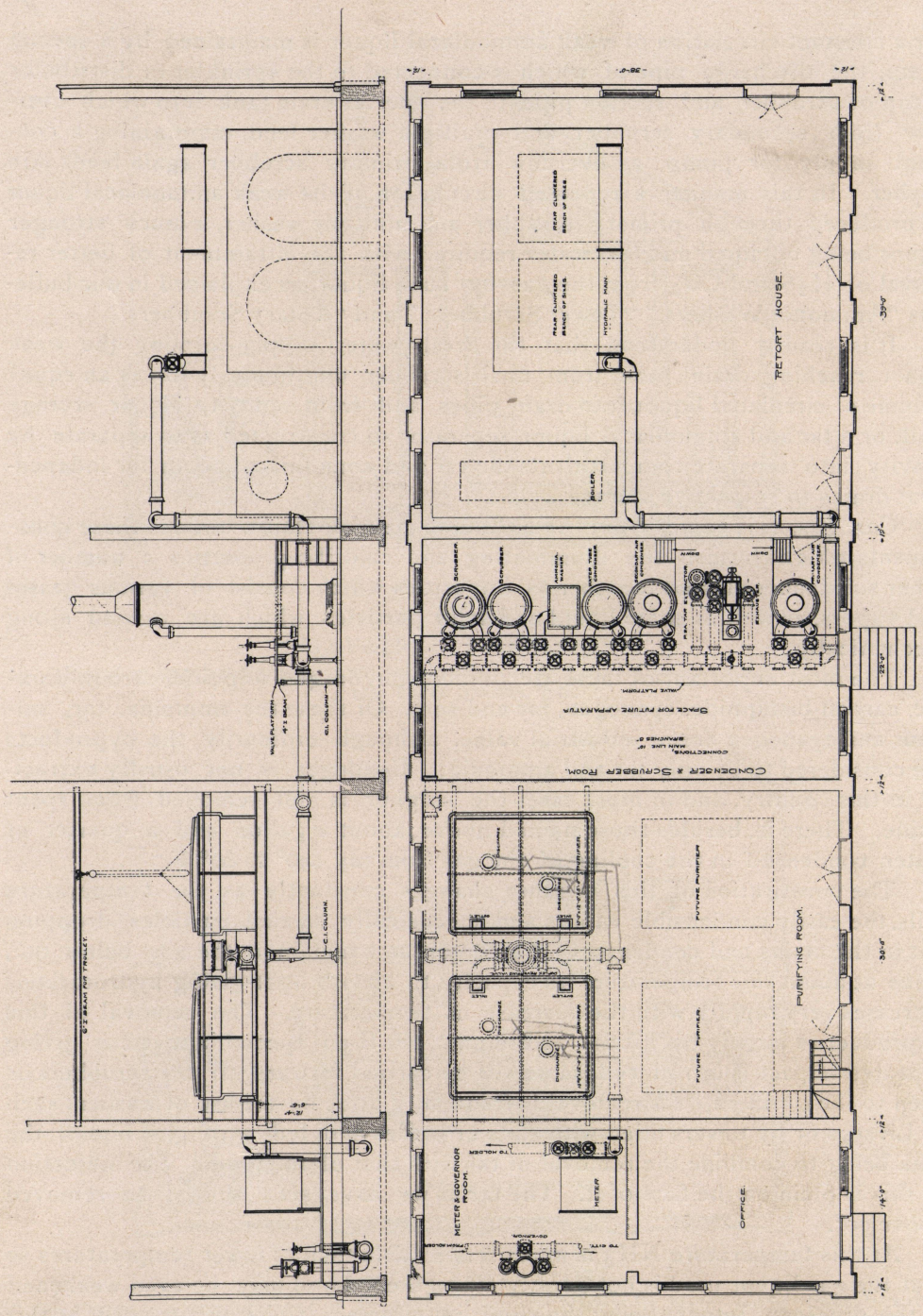

Fig. 6

The above illustrates a complete plant (except gas holder and yard tanks) for a daily output to a maximum of 120,000 cu. ft., arranged for doubling capacity by duplicating apparatus.

be self-regulating, that is, should give the same friction per cubic foot of gas passed regardless of variation in output, should be self-cleaning and not liable to become clogged by the separated tar. Only one machine fulfills these conditions, the tar extractor of Pelouze & Audoin. The saving in space due to use of this machine instead of other types is also greatly in its favor. The proper removal of the tar being dependent on temperature, it becomes necessary that there should be a regulator in front of this machine, that is a condenser capable of easy regulation and capacity sufficient to lower temperature from the temperatures of outlet of hydraulic to say 90° F.

Pelouze and Audoin.

It will be noted that thus far we have dwelt on no other impurities save tar, this being removed first in order of temperature.

Ammonia being so much more soluble in cold than in warm water is most easily dissolved when the gas reaches the lowest temperature to which it is to be subjected in the works.

Ammonia.

But before going into the matter of further condensation and the scrubbing of gas, let us note briefly the important chemical and physical properties of the compounds under consideration.

Ammonia, NH_3, is a colorless gas of density 0.5967, not combustible in the ordinary sense and can be condensed by cold and pressure into the mobile colorless liquid which boils at -28.3°F, and solidifies at -103°F to a white crystaline mass. Ammonia is strongly basic and unites with acid to form the salts of ammonia which are as a class volatile and not very stable, but mostly decomposed at low heat. The ones which concern us most are sulphides and carbonates.

The former are salts of the acid hydrogen sulphide H_2S. This is the exceedingly ill smelling compound which occurs in the decomposition of eggs, and in sulphur springs. It is combustible, the product being H_2O and SO_2. The latter is of noxious odor and having acid properties and therefore the necessity of its removal from illuminating gas. H_2S is a weak acid and as such forms salts with the strong base NH_3 such as NH_4HS and $(NH_4)_2S$ which are colorless and very soluble, as well as a number of less well defined polysulphides having greater percentage of sulphur. These latter compounds are yellow, and it is to these that the color of the gas liquor is largely due. None of these compounds are stable but are decomposed by heat, even being affected by light. They are oxidized to sulphates in the presence of air. Since the latter unlike the sulphides and carbonate are not volatile with heat, it is important that the wells containing gas liquor should not be exposed to the action of the air. The sulphides are broken up by heat with the evolution of NH_3 and H_2S. The other acid which concerns us is the one formed from the common products of carbon conbustion, CO_2. This gas is colorless and odorless of Sp. Grav. 1.529 and not a supporter of combustion.

Sulphurated Hydrogen.

Ammonium Compounds.

Carbonic Acid.

Contrary to the popular idea this gas is not poisonous, but its presence in sufficient quantity may be fatal since it will not support animal life. One volume of carbon dioxide in 100 volumes of illuminating gas is said to reduce candle

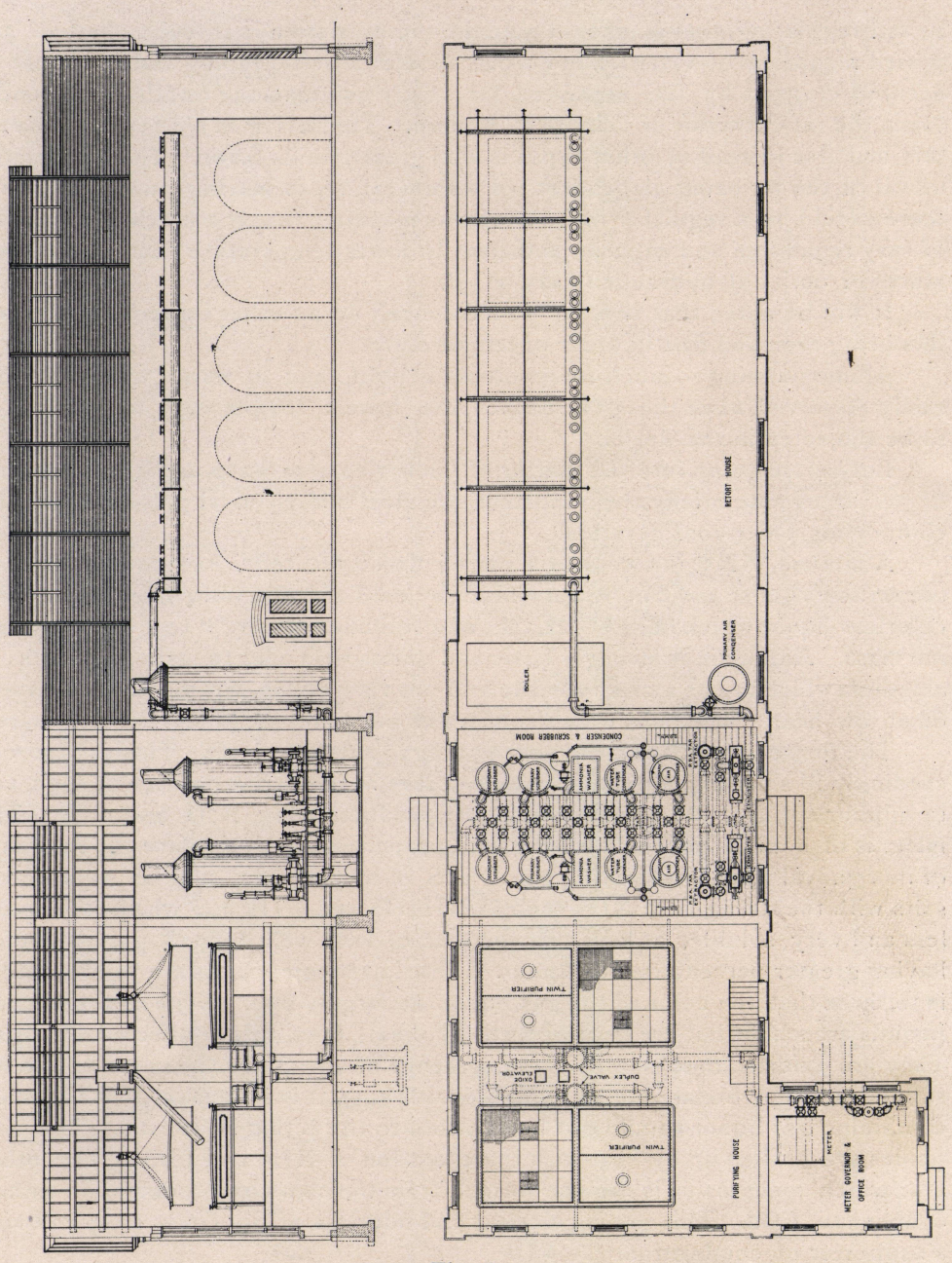

Fig. 7.

Plant similar to Fig. 6, but Retort House extended, and Condensing and Purifying Apparatus completed to full double unit installation except having single large Primary Condenser in Retort House. This illustrates a plant for about 300,000 cu. ft. daily capacity.

power to the extent of about 5 per cent. About one volume of CO_2 is soluble in water at 60°. This solution contains the hypothetical acid H_2CO_3 whose salts, the carbonates, are of such great importance. The salts are stronger than the sulphides as CO_2 will displace H_2S out of either gas liquor or fouled lime. This is to be remembered in purification by lime. The important ammonium salts are the neutral carbonate and the bicarbonate.

Carbon Bisulphide

Carbon bisulphide CS_2 (vapor density 2.645) is a colorless volatile liquid of fetid odor. It is valuable solvent for many organic bodies, and of sulphur. From this property its partial removal from gas by passing through spent oxide, that is oxide which contains a large percentage of free sulphur, is possible. Carbon bisulphide also unites with one of the sulphides of ammonia so that some of this impurity is removable in the scrubbers.

Bearing in mind these few properties of the impurities under consideration, we will now proceed with the matter of the treatment of gas after it leaves the tar extractor. Further condensation is necessary to bring it into the proper conditions for scrubbing. This should be done gradually, not suddenly, to prevent the undue deposition of desirable vapors causing loss of illuminating power. The drop of temperature from the extractor to the washer will be 40° to 50°. This then should be best accomplished by two condensers as giving more gradual cooling and better control under varying climatic conditions. At all points of the condensing system the water condensed will carry with it ammonia in amounts which increase rapidly as the temperature falls. The CO_2 and H_2S of course pass into solution also as salt of NH_3.

Condensing.

Scrubbing: The first unit in the scrubbing system should be a washer of the multiple immersion type, and its task is not only the removal of some NH_3, but particularly the catching of any traces of tar and suspended matter not previously removed and the retention of as much sulphide and carbonic acid as possible in the form of ammonia sulphide and carbonate. This washer may be fed with the liquid from the condenser or scrubber, or both. If the tar has been properly removed the strength of the liquor will be largely increased. At the same time the continued use of ammoniacal liquor tends to raise the relative amount of acid impurities absorbed. This is particularly true of the carbonates and fortunately so since in this country we often do not remove CO_2 at the purifiers. The gas now passes to a scrubber or pair of scrubbers, meeting in its course liquor more and more dilute until at last it is scrubbed with fresh water. In all scrubbing apparatus it is to be borne in mind that NH_3 in gas liquor is held so feebly by the acid constituents that it continually passes off as if in a free state. Over liquor of any given strength there is a certain amount of NH_3 at equilibrium with that dissolved in the liquor. If this liquor be used to scrub gas carrying more than this amount of NH_3 it will continue to absorb, but if the liquor carry more, ammonia will be evolved until an equilibrium is again reached. This shows the folly of washing gas with strong gas liquor when nearly clean. However, with properly constructed scrubbers and facilities for the

Scrubbing.

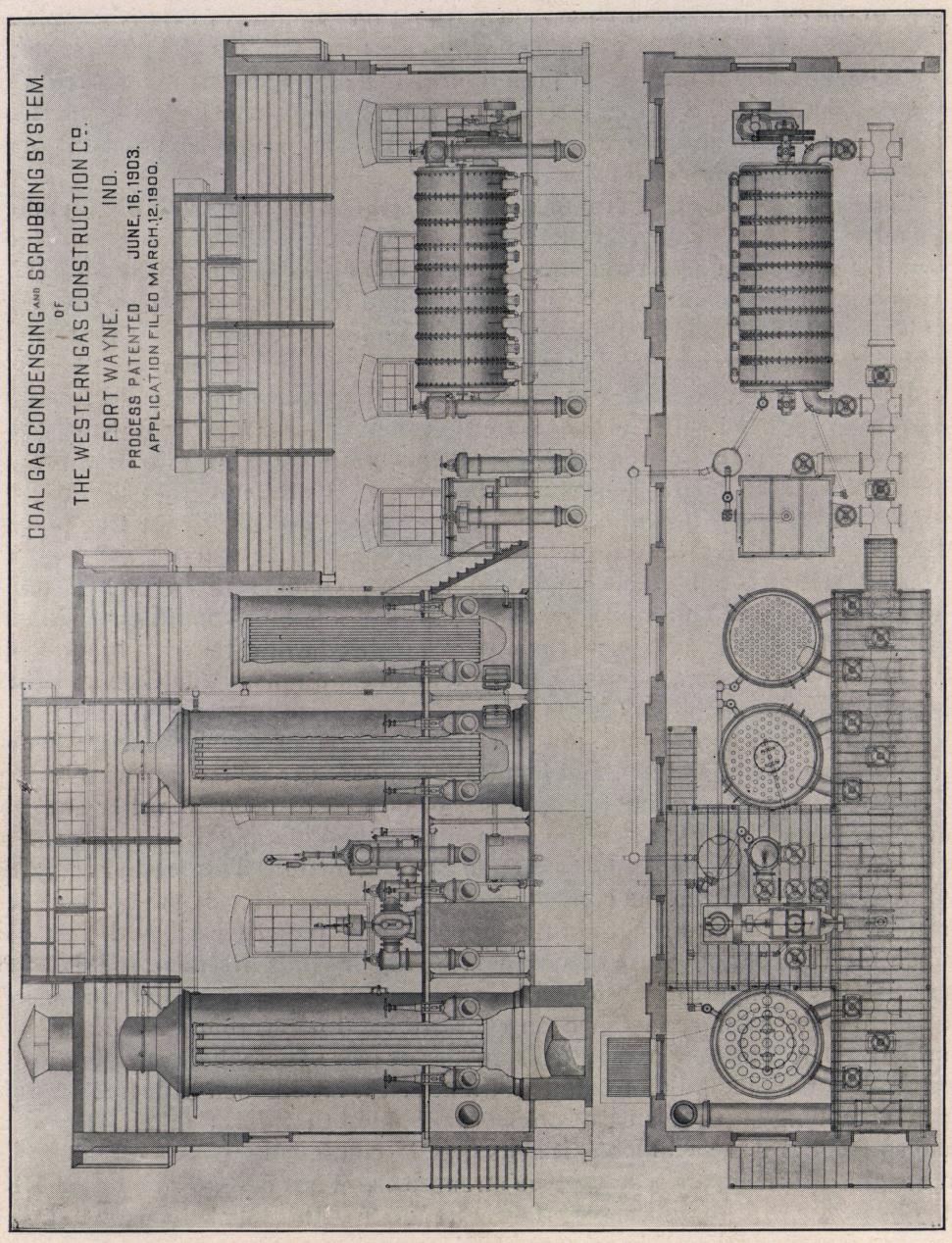
COAL GAS CONDENSING AND SCRUBBING SYSTEM.
OF
THE WESTERN GAS CONSTRUCTION CO.
FORT WAYNE. IND.
PROCESS PATENTED JUNE. 16. 1903.
APPLICATION FILED MARCH. 12. 1900.

Fig. 8.

Plan and part sectional elevation of plant adapted to capacity of from 250,000 to 750,000 cu. ft. per diem. Fig. 9 shows a plant of this type.

circulation of liquor in the first units of the system it becomes possible to bring the amount of fresh water used to a very small quantity, as low sometimes as half a gal. per 1000 cu. ft. There are many types of scrubbers in use, but none that are so compact and efficient as the rotaries. Of these machines the "NEW" scrubber washer of Holmes is on all points the most desirable (for detail and important features of this scrubber see Bulletin No. 202A, and the recent writers on gas and chemical engineering.)

Holmes Rotary Scrubber

If tower scrubbers are used, two should be used in series, fresh water introduced into the last only and the weak liquor overflowing from that to be pumped into the first, then passed by gravity to the washer. It is almost impossible

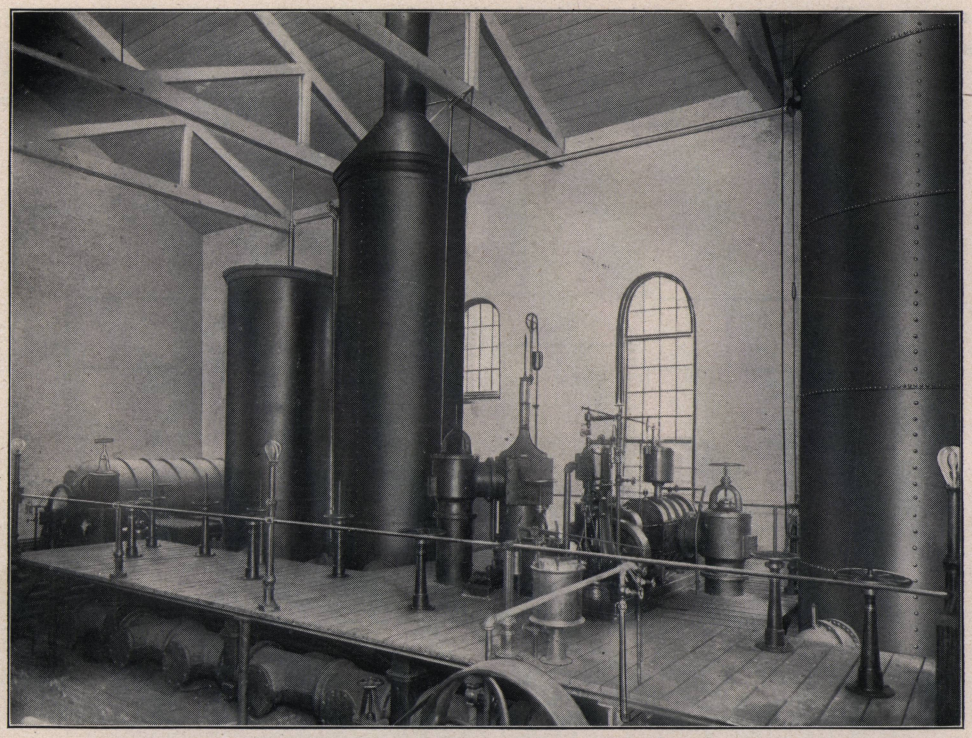

Fig. 9.
Coal Gas Condensing and Scrubbing Plant. New Bedford, Mass., 750,000 cu. ft. capacity. This plant was installed early in 1903 and is arranged for duplication of apparatus. In the foreground may be seen the gas governor and engine wheel of spare exhauster.

to understand how large plants can be satisfied with an ammonia liquor average of from ½ to ¾ per cent. (2 to 3 oz.), when with modern apparatus and intelligent supervision it is possible to easily obtain liquors of from 3 to 4 per cent. and still have well scrubbed gas. It is a matter of fact that gas may still be cleaned to a greater degree of purity than is usually done where only very diluted liquors are obtained. The saving of heat required in ammonia concentration and the storage capacity for crude liquor are matters that the Gas Companies can no longer neglect.

Liquor Recovered.

General Composition of Coal Gas.

As to the general condition of coal gas as delivered from the hydraulic main, it is well known that physically it consists of a mixture of gases, vapors, globules of liquids suspended in the gas and minute particles of solid matter, principally fixed carbon. The fixed gases are principally Hydrogen, Methane or Marsh Gas, with lesser quantities of Ethane, Propane and Butane, Ethylene or Olefiant Gas, with lesser quantities of Propylene and Butylene, Ethine or Acetylene, Carbon Monoxide, Carbon Dioxide, Hydrogen Sulphide, Ammonia, Nitrogen, Oxygen, and probably some of the gaseous Amines, mostly Methylamine. The vapors consist principally of small quantities of the Paraffin series, also small quantities of the Olefine series, Benzol, Toluol, and probably

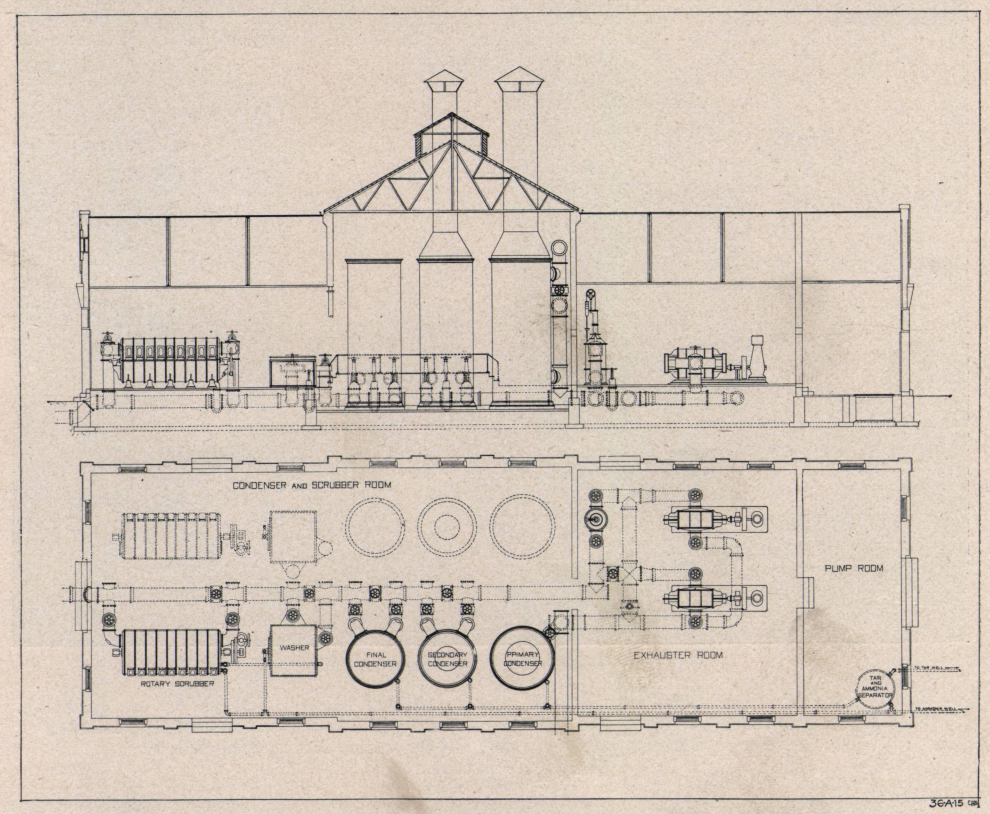

Fig. 10.

The above illustrates a typical plant for installations of capacity from 750,000 to 2,000,000 cu. ft., arranged for doubling capacity by duplication of apparatus. A plant of this type for 1,500,000 cu. ft. initial capacity was installed at Detroit in 1902.

Vapors Present.

some other member of the Benzol series, Carbon Disulphide, and Aqueous vapor, all of these vapors being of substances liquid at normal temperature. There are also present vapors of substances solid at normal temperature, princi-

pally Naphtalenes, Anthrenes, Phenols, occasionally some Pyrene and Chrysene, and also some Acid Ammonium Carbonate, and slight quantities of other Ammonium Salts.

The liquid globules carried in suspension in the gas, are made up mostly of bubbles of the various condensed vapors, and tarry matter, such bubbles enveloping usually vapor of the same substances with some fixed gas. Other liquid globules are simply minute drops of liquid so fine as to be carried along suspended in the gas. The solid matter carried with the gas is usually almost entirely fixed carbon in the form of soot and minute particles of coke. There are also often carried along with the gas, minute crystals of solid matter, principally Naphthalene, which crystals are formed in the mixture as it cools in passing along the pipes, thus reducing the vapor tension of the vapors mixed with the gas.

Entrained and Suspended Matter.

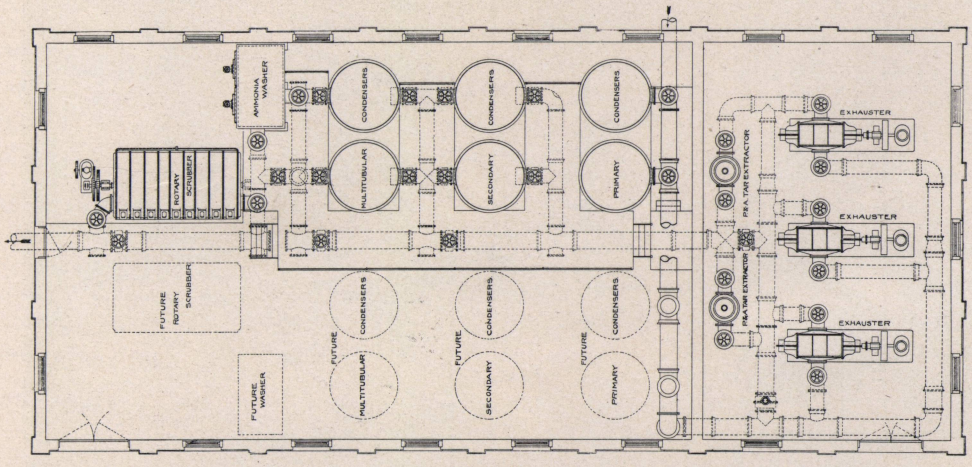

Fig. 11.

The above illustrates arrangement of multiple unit plant as installed at Cambridge in 1903. This type is generally used by us for plants up to 8,000,0000 daily capacity. This arrangement gives great convenience with unusual wide range of capacity.

Thus it will be seen that if a sample of gas could be taken at a certain temperature, and an analysis made at that temperature, some of the vapors would undoubtedly be found to be present in globules in excess of the quantities due to their vapor tension at the temperature taken. This being explained by the fact that although the gas might be at saturation with certain vapor, there might also be a fine mist of minute globules of the same substances carried along mechanically, as entrained water in steam is carried. All of the liquid and solid matter carried by the gas, must, of course be removed, as it cannot be carried by the gas in the distribution system, and portions of it are thus removed by considerable change in the velocity of the gas, allowing the globules to agglomerate and de-

Excess of Vapors.

Removal of Solids and Liquids.

posit in practically the same manner as globules of water in a cloud produce rain. As this process requires time and bulky apparatus, it is best accomplished, partly by the Primary Air Condenser, and the rest by a screening and impact process, by passing the gas through fine holes with sudden change of direction, as in the Pelouze & Audoin Tar Extractor. During the reduction of these matters in the primary air condenser the temperature is at the same time *and under absolute control* reduced to a point best suited for the removal of the tar, because as the tar is an absorbant of Naphthalene, its capacity increasing with the

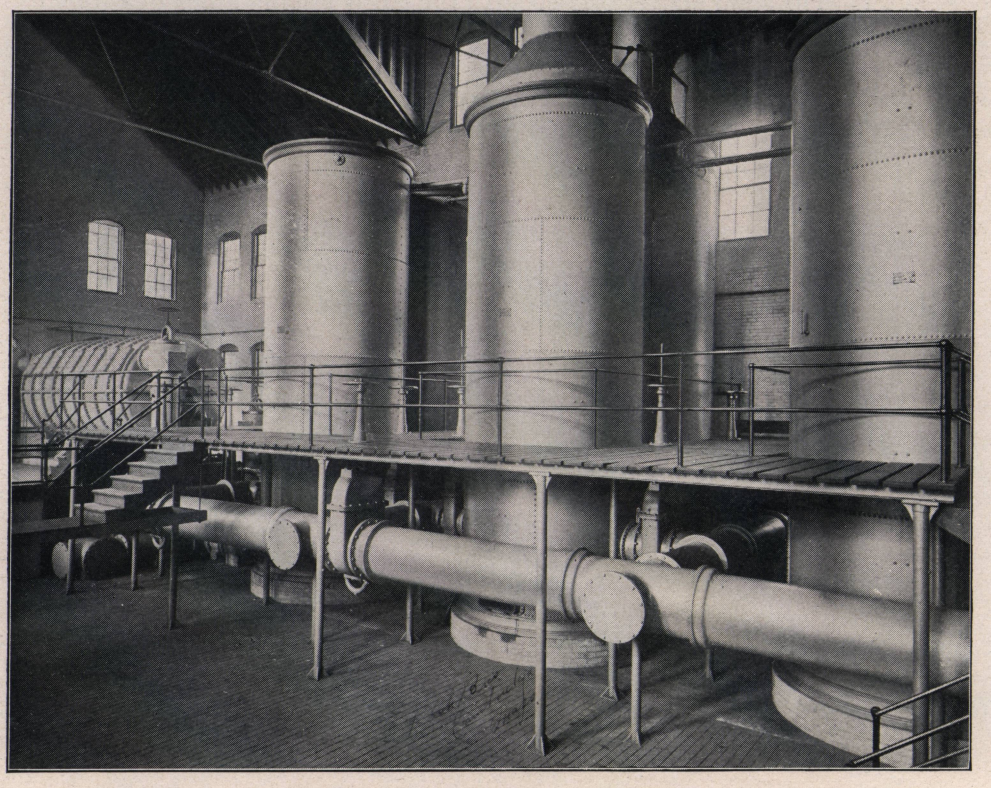

Fig. 12.
Showing 2,000,000 cu. ft. multiple unit plant as installed at Cambridge, Mass.
View looking towards exhauster room.

Temperature Important.

reduction of temperature, the tar vapors are allowed to remain with the gas to as low a temperature as may be for the absorption of the Naphthalene, but as tar vapor is also an absorbant for the hydrocarbons required for illuminating purposes, the temperature should not be allowed to go down so low that the illuminants will be removed from the gas to an injurious extent.

Not Below 90 °F.

It has been found by careful experiment, that with coal gas, this temperature should not go below 90° Fahrenheit, hence, the air condenser, accomplishes the removal of the finely divided liquid matter, and much of the fixed carbon at the

same time cooling the gas to a point where the balance of the tar should be entirely removed, which is done by our P. & A. tar extractor, *under regulated conditions of temperature and pressure.*

The suspended liquids and tar, and other liquids having been removed, the gas is ready for the condensation of the excess of other vapors, and cooling to the proper temperature for the removal of the ammonia, as the vapors remaining in the gas will be condensed and deposited in very close accordance with their vapor tensions corresponding to the different stages of temperature, and as many of them are solvents for others, it will be readily understood that this period of condensation and cooling must be handled with great care, in order

Condensation of Vapors.

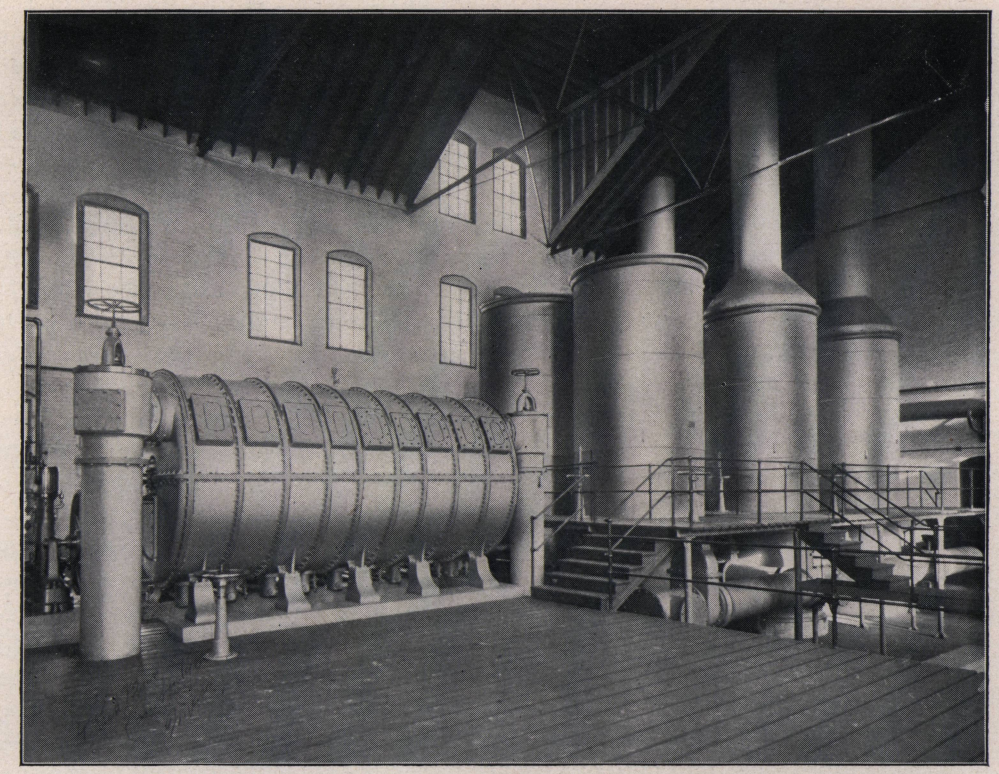

Fig. 13.
Showing Cambridge plant same as Fig. 12, but looking from exhauster room.

that the undesirable vapors may be removed without permitting undue reduction of the vapors which are to remain with the gas. It is therefore, particularly necessary that this period of condensation and cooling be divided into stages, and that the vapors first condensed shall be removed and prevented from contact with the gas in the second stage,

The quantities of any vapors that can be carried into the distribution may be illustrated by the Benzol as carrying the Naphthalene, for instance, at

any temperature, say 70°, there will be a certain amount of Naphthalene vapor stay with the gas according to the vapor tension of the Naphthalene at that temperature and the Benzol will also be present in the gas in a certain quantity due to its vapor tension at that temperature, but as Benzol is a solvent of Naphthalene, it is found that the amount of Naphthalene vapor in the gas may, in the presence of Benzol, exceed the quantity corresponding to its simple vapor tension, on account of the carrying power of it solvent, the Benzol It is also found although liquid water is not a solvent for Naphthalene, the Aqueous vapor will carry a quantity of vapor of Naphthalene

Physical Relation of Vapors.

This is illustrated by the condensation in the street mains, as where the Benzol is present in considerable quantities and also the Naphthalene not in excessive quantity, the gas being cooled reduces the vapor tension and both Naphthalene and Benzol will be condensed, but the liquid Benzol will dissolve the Naphthalene and the drip from the pipe will be pumped as a clear liquid and the Naphthalene will not cause trouble, but if the quantity ot Naphthalene with the gas be considerable and carried not only by the Benzol but by the Aqueous and other vapors, and the Benzol be not present in large quantities, the condensation in the street main by reduction of temperature, will show deposition of Crystalline Naphthalene, due to the fact that as the Naphthalene is deposited the portion carried by the Benzol may be dissolved by it but the excess carried by the Aqueous vapor, and other vapors, when deposited finds no solvent and therefore crystalizes in solid form, continuation of this process finally filling the pipe and causing the obstruction so annoying to the gas men. It is to guard against these annoyances that our system of coal gas condensation was developed, and with proper conditions of carbonization of the coal, the most excellent results are realized.

Illustrated by Benzol and Naphthalene.

Our system of coal gas apparatus is developed not only from scientific research, but from many careful experiments on commercial scale which so thoroughly demonstrated the correctness of our research work and the results were of so great importance commercially, in our judgment, as to justify application for patent, which resulted in their recognition by the United States and Foreign Patent Offices as being of fundamental character, and process patents being granted. As a result we are prepared to meet any practical conditions, especially as we are the only Gas Construction Company in this country whose engineers have had practical experience in the successful operating for any length of time of a wide variety of gas plants, large and small, so that we are fully equipped to install plants that will not only meet the requirements of the financial management as to commercial results, but also to meet the approbation of the engineers, superintendents and foremen, by avoiding those petty and often serious annoyances resulting from the installation of miscellaneous apparatus as to often put in by builders whose technical knowledge and experience in operating are based largely on general observation of other builders work.

Our Process Fundamental in Character.

Successful Under Various Requirements.

CLAIMS ALLOWED

— IN —

UNITED STATES PATENT No. 731,412.

ISSUED JUNE 16, 1903.

Having described my invention, which I claim as new, and desire to secure by Letters Patent, is—

1. The method of treating coal-gas for the removal of tar, ammoniacal liquor and other by-products, and preventing loss of volatile illuminants which consists in cooling said gas and regulating said cooling operation at a temperature above 90° Fahrenheit, thereby removing part of the mechanically-suspended tar, then, by dry mechanical impact or precipitation, extracting the remaining tar.

2. The method of treating coal-gas for the removal of tar, ammoniacal liquor and other by-products, and preventing loss of volatile illuminants which consists in cooling said gas and regulating said cooling operation at a temperature above 90° Fahrenheit, thereby removing part of the mechanically-suspended tar, then, by dry mechanical impact or precipitation, extracting the remaining tar, and subsequently cooling the gas and extracting the ammonia at a lower temperature.

3. In the treatment of coal-gas, the hereindescribed method of removing the tar and preventing loss of illuminants, which consists in gradually cooling the gas as delivered from the generator and maintaining it at a regulated and determined temperature above 90° Fahrenheit, and extracting the tar by dry mechanical precipitation, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

OLAF N. GULDLIN.

Witnesses:

ERNEST F. LLOYD.

THOMAS J. CREGHTON.

The Western Gas Construction Co.

"THE WESTERN"
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In units of from

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